

**Deer Control:
A Basic Element in the Integrated
Management of Ticks That Carry Lyme Disease**

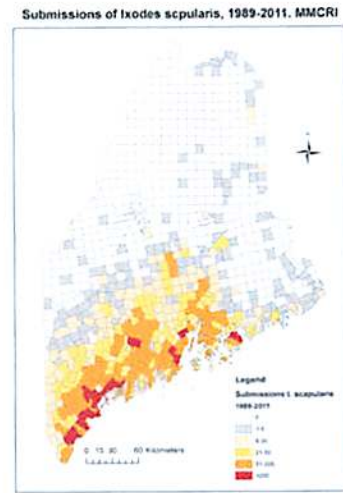
A Community Guide

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Introduction

Deer ticks (*Ixodes scapularis/dammini*), also known as black-legged ticks, transmit the agents of Lyme disease, anaplasmosis and babesiosis from small mammals in the wild to man and domestic animals. They were first reported in Maine on a deer killed in Jackman in 1986 (1) and from vegetation on Mt. Desert Island in 1987 (2). Since then, these ticks have become well-established in coastal counties and throughout the southern half of the state to the western foothills (3) (Fig 1). Before 1990, only eight cases of Lyme disease had been reported to the state Bureau of health. In 2011, 1002 were reported (4) (Fig. 2). It is estimated that only one in six cases of Lyme disease is reported (5), which suggests that the true number of people infected that year was around 6000. At the local level, in the early 1990s we found that about 10% of the year-round residents on Monhegan Island had been exposed to the bacterium (6), and on Islesboro, the number of cases diagnosed by the Island Health Clinic increased from less than ten in the five years 2003- 2007 to more than 27 in 2011 (7).



This results in a direct relationship between the abundance of deer and the abundance of deer ticks. For example, in southern Maine where we estimated the deer presence by counting fecal pellet groups and tick abundance by sweeping vegetation with corduroy “flags”, we found few ticks when estimated deer numbers dropped below 15 per square mile (8)(Fig 4). Others have suggested that deer number may have to drop below 10 per square mile before the tick life cycle can be broken.

The effectiveness of reducing deer populations to reduce both ticks and Lyme disease has been documented by several field studies:

- Following a reduction in deer from 30 to a maintained 6/mi² on a coastal Cape Cod island, the number of deer ticks feeding on small mammal hosts dropped 10-fold and the number of human Lyme cases, previously 30% of the island’s 220 residents dropped to a total of three tick-borne diseases over the following 16 years (9).
- Two years following a reduction in deer density from 77/mi² to 10/mi² the incidence of Lyme disease among residents of Mumford Cove, Connecticut, decreased by 83% (10).
- On Monhegan Island, adult ticks collected from vegetation per hour dropped from ~17 to less than 2 within 3 years following removal of a deer herd that had reached 113 per square mile (11).(Fig. 5) Only one case of Lyme disease was reported over the following decade.



Figure 3. Eggs deposited by an adult deer tick.

On the other hand, one study (12) found no change in deer ticks or Lyme disease following a reduction in deer density from ~118 to ~63 per square mile. Note, from Figure 4 (at right), that deer density has to be lowered far below 68/mi² to effectively lower tick abundance.

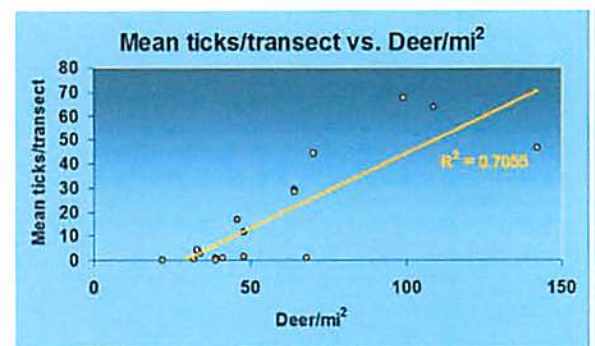


Figure 4. Abundance of *Ixodes scapularis* ticks versus estimated deer densities at several sites in southern Maine, 1998-2000.

Where it can be accomplished, therefore, deer reduction should be included as a base for an integrated program to reduce the abundance of disease-carrying ticks at the community level.

At the individual level, several effective approaches are available to prevent tick bites: repellents containing DEET or Picaradin, tick-killing clothing sprays containing permethrin, and (most importantly) post-exposure tick checks. Other ways to control ticks on residential property are to remove tick-friendly habitats, to lure tick hosts into devices that coat them with tick-killing pesticides (acaricides), and, principally, to treat tick habitat with either spray or granular acaricides. Synthetic or botanical acaricides professionally applied by high pressure spray into the leaf litter can be very effective (9). In most cases, however, the application of an acaricide over an entire community will be prohibitive technically, financially and politically.

Deer reduction, while effective where it can be carried out, has caveats.

- Access to offsite deer has to be limited. The studies referred to above were conducted either on islands or inside an effective deer barrier. Where practical, deer fencing has been shown to lower tick abundance. Small mammals, however, may deposit infected, sub-adult ticks well within the fence line which will then represent a risk when molted to nymphs or adults.
- Where deer access cannot be completely restricted, and depending on deer reproductive success, an annual maintenance deer control program will be needed once the initial population is reduced.
- Because it takes at least two years for completion of the deer tick's life cycle, tick control will not be immediate. Indeed, in the fall of the first year after a

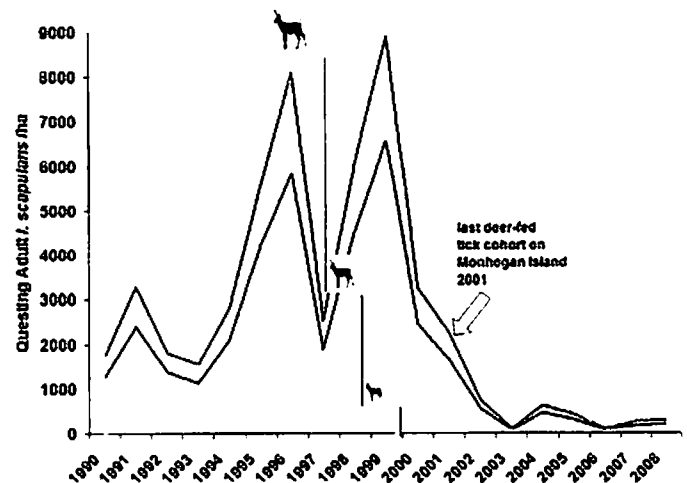


Figure 5. Abundance of *Ixodes scapularis* after removal of deer from Monhegan Island, ME. 1990-2008.

substantial deer reduction, when not finding deer to feed on, exposure to questing adult deer ticks may increase.(11)

Therefore, communities with the greatest chance of success in lowering deer herd density are those with overabundant deer (over-browsing, deer/vehicle crashes, tick-borne diseases) where access to outside deer is, or can be, limited (islands, peninsulas, or areas that can be excluded by fencing), and a **motivated citizenry**. In those cases where adjacent islands or communities also support over-abundant deer populations, collaboration might result in a more effective deer reduction program.

Steps to lowering a community's deer density to control disease-carrying ticks.

This process involves focusing the community's concern, educating the residents and town officials, and collaborating with the biologists from the Maine Department of Inland Fisheries and Wildlife to develop an appropriate deer control program. After presentation to the public and acceptance by the select board or council, this is submitted to IF&W for approval.

1. After preliminary meetings by concerned citizens, establish a **tick control committee**. Additional members might include local health care providers (both human and veterinary), hunters, school representatives, select board members. To speed communication and action, the committee should eventually, if not initially, be town-appointed and advisory to the town's governing body. Its purposes should be to:
 - Establish the risk, by consulting with healthcare providers, tick experts, and wildlife biologists
 - Educate the property owners, town administrators, stakeholders (hunters, lobstermen)
 - Involve supporting partners (Maine Department of Inland Fisheries & Wildlife Fisheries and Wildlife, local health providers, MMC Vector-borne Disease Lab, wildlife surveyors)
2. Obtain and review two excellent and comprehensive publications, Tick Management Handbook (14), and Managing Urban Deer in Connecticut (10). Copies of the

Frequently asked questions

Q. Isn't the problem the mice and small mammals the ticks feed on?

A. Certainly small mammals play a major role in supporting deer ticks as they both feed (and infect) both larvae and nymphs. But to stop the tick cycle you've got to stop reproduction, and that happens when the ticks mate on deer, and the females feed on the blood that they will use to create thousands of eggs. Besides, it would be ecologically disastrous, indeed impossible, to kill off all mice, squirrels, voles....

Q. Aren't there other ways of reducing deer numbers without killing them?

A. Yes, there are two: trapping and moving, and immunocontraception. Trapping deer is very stressful and carries a high fatality risk. It is extremely labor-intensive and involves high transportation costs. It is not a method to reduce deer herds. Immunocontraception, a birth control method involving gathering, tranquilizing and vaccinating the female half of the deer population, is not practical. It does diminish reproduction but does nothing to reduce current deer density. Maine IF&W considers this method neither safe nor effective.

Q. Are there ways to kill the ticks on deer?

A. Yes, there's a device called a "4-poster. (Fig. 6) It consist of a box from which twice-washed, whole kernel corn is supplied to a feeding tray which sits between two pairs of permethrin-saturated vertical rollers. To reach the corn, a deer has to place its head through the rollers, which apply the acaricide to its neck. In initial trials, when distributed at one unit per 52 acres, these devices achieved 60-82% tick reduction within three years. But there are problems. Where deer are abundant and natural feed is limited, 4-posters may need refilling 3 times weekly. Where natural feed is abundant, deer don't visit the devices. The corn, although twice washed, may still mold and clog the feeders, particularly when they are invaded by chipmunks and squirrels. The initial package of four 4-posters with accessories is sold by Dandux Outdoors, Ellicot City, MD for \$914 per unit (x4 = ~\$3600)(via A. Zulinski, 800-033-2638, ext. 8). Wildlife agencies, concerned that clustering deer at feeders may increase the risk of spreading other deer-prone diseases such as chronic wasting



Figure 6: A "4-poster" deer baiting device designed to apply an acaricide to the necks of feeding deer.

Handbook, which can be downloaded from the internet, www.gov.ct/caes should also be provided for the public in the community's library.

3. Determine the current risk:

What is the annual number of Lyme disease cases? Has it increased? Maine CDC may be willing to release these data only on a county basis, but area health clinics or local physicians may have useful estimates. Where collaboration is gained with a local clinic, their staff will need to establish criteria for diagnosing Lyme disease and other tick-borne diseases that can be applied realistically in an island setting. Because the classical signs and symptoms of the disease are not always present, differentiation needs to be made between “true” cases (likely exposure followed by a characteristic rash or appropriate symptoms and positive laboratory findings (15), and “suspected” cases (those with no rash but appropriate symptoms in which treatment was initiated without laboratory testing).

How abundant are local deer ticks and how infected are they? Baseline data will be needed to gauge the success of any tick control approach. Tick abundance is best measured by the number of ticks collected per hour by dragging a 1m² corduroy or flannel “flag” over vegetation at the height of the nymphal tick season in July or the adult tick season in October-November. The percentage of ticks infected can then be determined microscopically in the laboratory. These services are available at the Maine Medical Center’s Vector-borne Disease Laboratory (see Resources). In many instances, participation in tick surveillance activities such as vegetation flagging can be incorporated into school curricula for programs such as high school or college-level biology, health, or environmental science. Such programs have been used in some Maine communities, with the protocol available for public use (see ‘Resources’).

4. Estimate the deer population:

Despite the inherent inaccuracy of all methods of counting deer, it is important to adopt at least one in order to follow the progress of the deer control program. They include:

- **Browse surveys:** As deer populations reach carrying capacity, the animals will forage more intensively on preferred, and then on less preferred, vegetation, providing a very rough index of their overabundance.

- **Annual deer harvest:** Variations in the number of hunters, weather limitations (i.e., no snow, high winds and rain), and deer that are checked remotely all confound the accuracy of this method; but long-term trends will support other evidence of shifts in the deer population.



- **Automated camera and image capture:** used as a method for mark-recapture estimates. Motion-sensor cameras may be placed at key locations to monitor the number of deer active in an area continuously.
- **Night spotting:** this involves driving along standard road transects at night sweeping the woods with high- intensity searchlights and counting reflections from deer's eyes.

- **Pellet group count surveys:** A count of the number of deer pellet groups along measured transects through deer habitat, when multiplied by a standard assumption of defecations per day, provides an estimate of deer density which can be expressed as deer per square mile. This should be conducted by a qualified biologist.



- **Aerial surveys:** Typically conducted from fixed wing aircraft, perhaps aided by infrared sensors, but more recently and more accurately carried out in specially modified helicopters with independent observers in the front and back counting deer over transects of specified width (16). Aerial surveys are confounded by thick canopy and are best carried out in early winter when

leaves are off deciduous trees and the ground is snow-covered, or in the spring when there is still residual snow on the ground.

Deer density estimates from sighting or browsing damage can be very misleading. For example, year-round Monhegan residents thought there were ~40 deer on their island prior to the deer cull which put the number at 113. The two last methods, which are systematic surveys, provide numerical indices which, though prone to errors, are still valuable for planning what kind of control is needed and for providing an index of progress.

5. Evaluate deer reduction options

Deer are the property of the State of Maine and are managed by the Department of Inland Fisheries and Wildlife. The advice and collaboration of representatives of that agency, usually your area's wildlife biologist (see Resources), with input from the state's deer and moose biologist, Lee Kantar, should be an early order of business for the committee. They will explain the steps involved in seeking permits for any modification of present deer management regulations that would fit your town and your plan's specific needs. For a list of IF&W regional biologists, see Resources

6. Determine the public's concern:

The community's perception of the risk of being bitten by infected ticks and its attitudes toward deer removal will guide the committee's educational priorities and focus. The task of relating to, educating, and guiding a group of independent individuals, some with entrenched perceptions, contrary agendas and strong passions, is likely to be the committee's greatest challenge. Community surveys can be designed to provide helpful input. They may also be helpful in identifying valuable new members or supporters.

disease and bovine tuberculosis, have banned 4-posters in four northeastern states. Maine is reviewing the issue currently.

Q. What happens to the deer that are shot?

A. It will depend on what management plan is put together. Where overabundance is so intense that an initial sharpshooter may be contracted, the venison will go via IF&W to the Maine Department of Agriculture's Hunters for the Hungry Program. Otherwise, unless other arrangements are made, it will go to the hunter.

Deer and ticks and tick-borne diseases have evolved together over millenia, but Lyme disease is a problem that did not exist in Maine before the 1980s. A combination of changing land use (abandoned farms, rural expansion), loss of predators (including humans where excluded), and perhaps changing climate, has resulted in very high deer densities in some areas, followed by burgeoning populations of vector deer ticks.

Integrated pest management – the use of more than one strategy to address a problem, has become accepted practice in agriculture and is now by far the most effective approach to controlling ticks around homes, farms, and broader communities. Bringing deer to a more natural balance is a fundamental first step in reducing the risk of tick-borne diseases.

Resources

Tick Management Handbook: www.gov.ct/caes

Managing Urban Deer in Connecticut: www.ct.gov/dph/lib/dph/urbandeer07.pdf

IF&W Regional biologists: <http://www.maine.gov/ifw/contactus.htm#regionalheadquarters>

Maine Deer and moose biologist: Lee.Kantar@maine.gov

Maine Medical Center Vector-borne Disease Laboratory: (207) 662-7142; ticklab@mmc.org;
www.mmcri.org/lyme

Tick-borne Diseases on Islesboro: the Problem, the Causes, the Solutions:
<http://townofislesboro.com/fileadmin/Committees/TickBDPC>

Deer population estimators: Stantec, Inc, Scarborough, ME: www.stantec.com
Biodiversity Institute, Gorham, ME: www.briloon.org

Lyme disease in Maine: www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/lyme/

Protocol for Collecting Ticks: ticklab@mmc.org

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